

# Results of molten salt component tests with the TESIS:com facility

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## Introduction

Concentrating solar thermal power plants often use molten salt as storage and/or heat transfer medium. Compared to commercial plants using thermal oil, the use of molten salt can reduce plant complexity and increase efficiency. However, the molten salt medium and the higher operating temperatures place high requirements on the plant components. As part of the BMWi funded project "MComp", the presented work summarizes the requirements for molten salt component tests for tower and trough applications. In addition, results of loop tests with valves and flanges in operation with solar salt at the TESIS:com test facility were conducted.

The valves in the plants are mainly of the type globe and butterfly with nominal diameters between DN50 and DN500. The valve cycles show a high variation according to their function and position. Control valves reach up to 100,000 or more cycles, while others may have less than 100 cycles during the plant life.

## Test campaign

In the test campaign, three flange connections and two shut-off valves with packings (pneumatic and electric actuator) were connected in series.

With a renewed packing 1,300 cycles were reached before leakage. As there are several valves in a solar field where much less than 5,000 cycles can be expected in the "cold" part at 290 °C, and less than 1,300 cycles in the hot part at 560 °C, the results are encouraging for a future use of such valves.

Tests are currently being conducted with a new packing consisting of sealings with a more salt-resistant surface layer. In addition, insulation and trace heating in the area of the packing have been improved to prevent salt crystallization even at low temperatures.

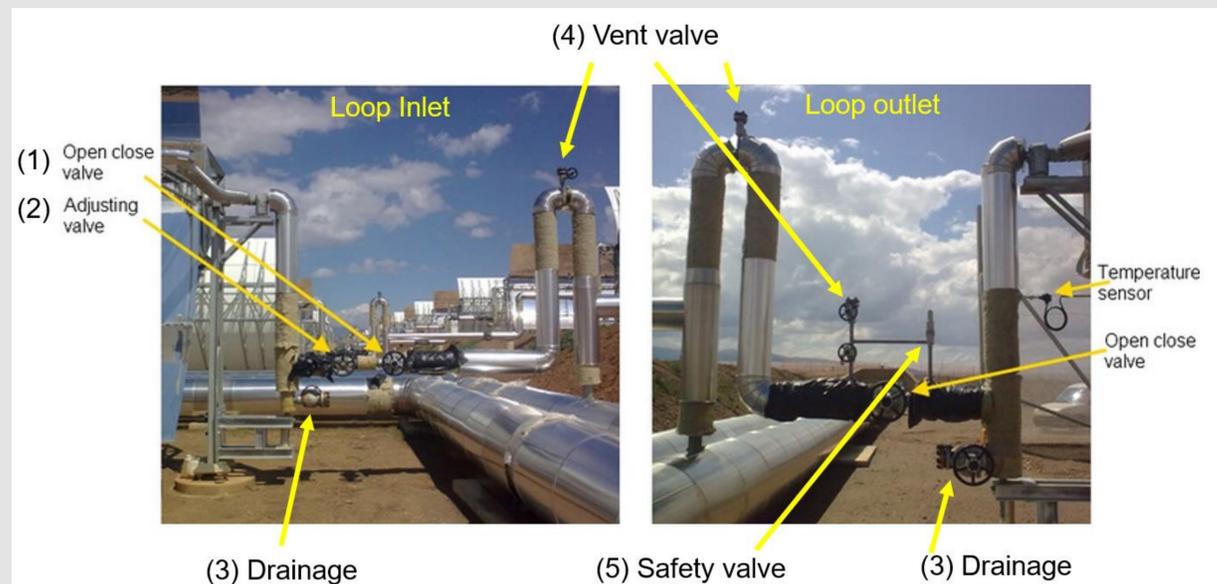


Figure 1: Example for positions of valves in a parabolic trough field (Photo: Schlierbach, Andasol 3 Marquesado Solar-)

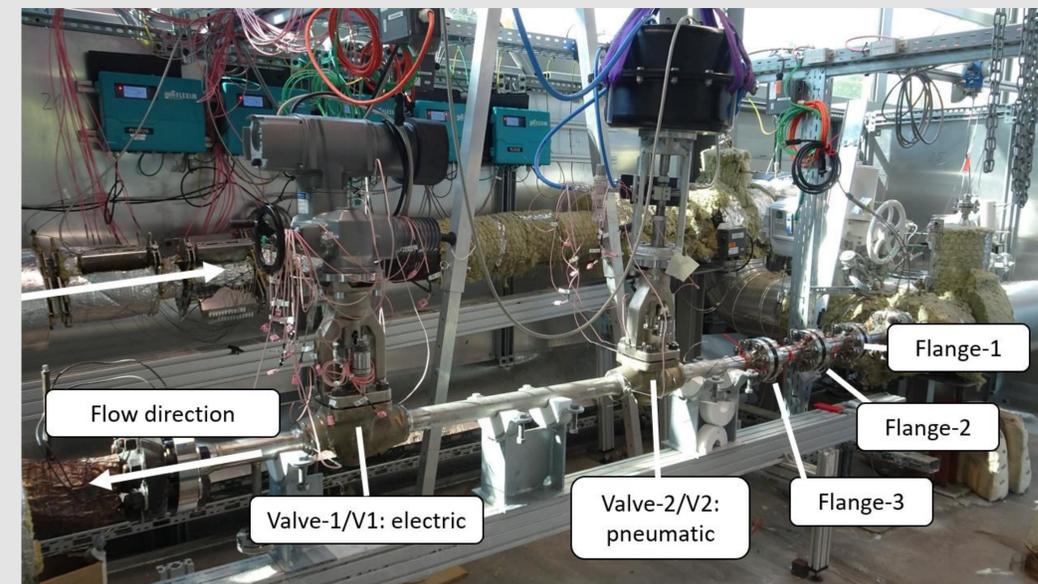


Figure 2: Test setup during first experimental campaign (Photo DLR)

## Requirements for components in solar thermal power plants

Initially, process-related and individual requirements for the components were defined from standards, publications and operating experience. In general, components in the "cold" loop upstream of the receivers are operated with temperatures of 290 °C and pressures up to 40 bar (trough, Fresnel) or 80 bar (tower). In the hot parts of the loop, a maximum salt temperature of 560 °C, or 650 °C wall temperature, is reached. The individual requirements for the components are different and depend on their tasks and the planned operating time.

Figure 1 gives an impression of valves at the loop entry and outlet in a parabolic trough field. The planned service life of the plants and thus also of the components is 30 years.

The component test section of the TESIS:com facility is operated with Solar Salt at temperatures between 290 °C and 560 °C, mass flow rates from 0.5 kg/s to 8.0 kg/s and temperature ramps of up to 100 K/s.

The two DN50 globe valves were delivered by Persta without valve spindle heating and bellows. 5,000 full open/close cycles at 290 °C were completed without leakage. Subsequently, tests at 560 °C were started. Leakages were detected on both valves after approx. 160 cycles. The leakage is attributed to salt crystallization in the area of the valve spindle during the cycles at 290 °C. The solid salt crystals graded the spindle as well as the packing of the valves during cycling. At the 560 °C tests, the temperatures in the valve increased above the melting temperature and liquid salt mixed with graphite leaked out.

See the full paper for more details also on testing of flanges.

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